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TEXTILE RESEARCH

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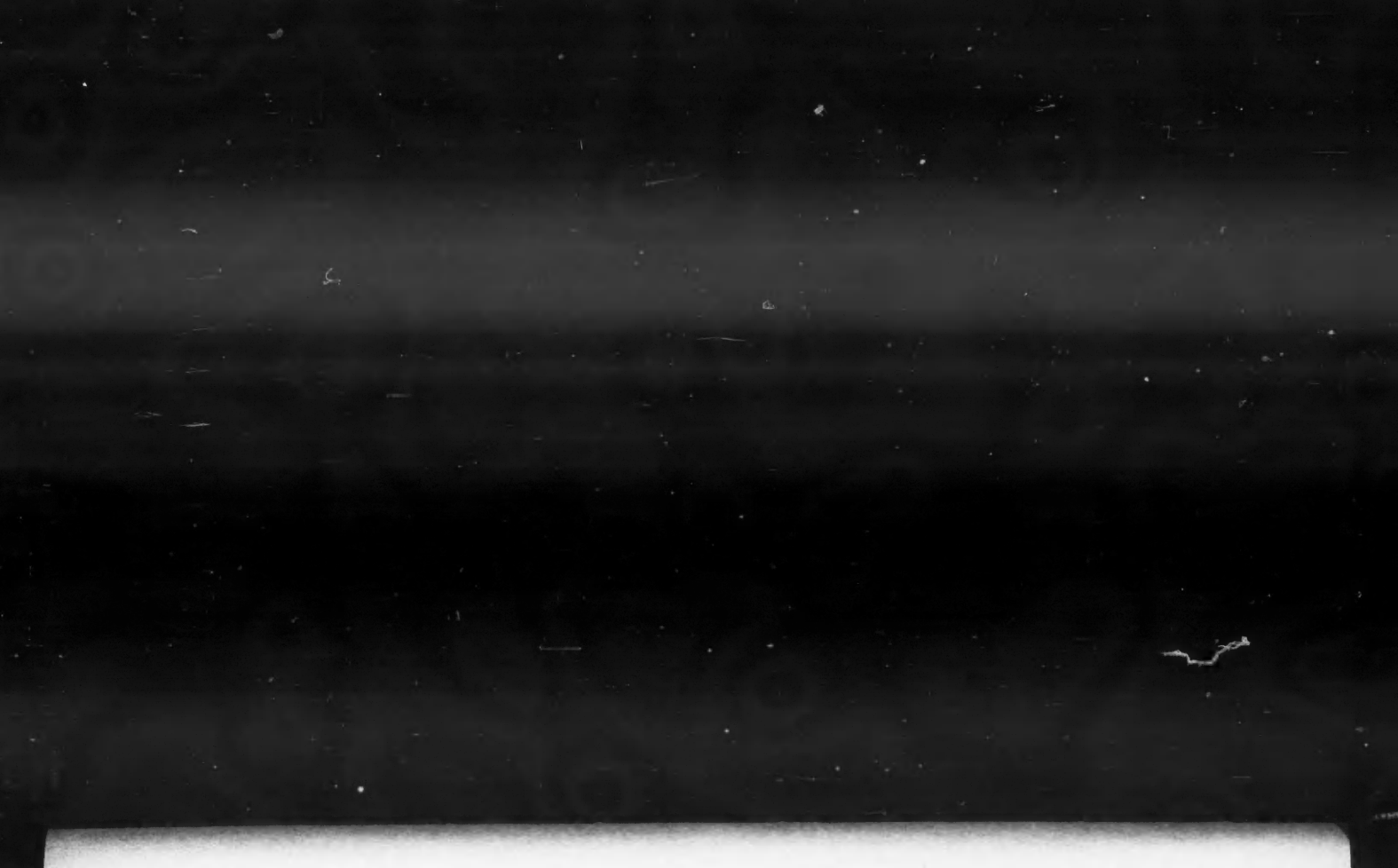

In This Month's Issue

Institute Offers Research Fellowships

The Textile Research Institute's program of graduate training is in effect at Princeton, N. J. (See page 354.)

Post-War Textile Economic Research Project

An outline is given of the Institute's economic research project which involves a study of the probable competitive position of the American textile industry in the post-war era. (See page 355.)

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An Industrial Research Department

Essential factors to be considered in the organization and operation of an industrial research department are discussed. (See page 359.)

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Photomicrography of Textiles for Legal Purposes

An application of modern photographic technique which brings out the perspective or three-dimensional, space relationship of the various components in a textile is shown. (See page 366.)

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The Effects of Stripping on Card Sliver Size

The amount of time required for a card to reach its normal operating condition after stripping has been experimentally determined. (See page 370.)

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Dimensions for Expressing Strength of Textiles

Rapid increase in the consideration of textile materials from an engineering viewpoint lends emphasis to the need for accurate and uniform terminology for expressing a simple property of material such as strength. (See page 374.)

Graduate Training Program Under Way According to Announcement That the

Institute Offers Research Fellowships

The Textile Research Institute's program of graduate training will go into effect at Princeton, N. J., commencing Nov. 1, 1944. Through this program, the Institute will offer a number of research fellowships. The fellows will have an opportunity to work toward their Doctor's Degree at Princeton University, and also to do research work in the laboratories of the Textile Research Institute at Princeton. Those accepted as fellows will receive $700 per year, and the Institute will also pay the graduate tuition fees.

This program was developed out of the recognition that one of the great needs of the textile industry is an ample and continuing supply of scientifically trained research workers to carry on the projects of the various research groups, and to man the research staffs of individual companies. The majority of the graduate students will be engaged in study involving technical research but it is planned to include each year a few graduate students in the field of economic research.

Dr. Henry Eyring.

In a statement made by Princeton University at the time the plan for the graduate training program was first announced by the Institute, the following information was included: "In accordance with a practice already established in its relations with research institutions in the community, the University would expect to make available to properly qualified personnel of the Textile Research Institute the opportunity to enroll in graduate courses and proceed to advanced degrees in Princeton University so far as this could be achieved within the restrictive quota regulations that govern the operation of the Graduate School. The program of study and the research work of those so involved would be arranged to the mutual satisfaction of both the Graduate School and the Textile Research Institute."

Prospective fellows are invited to send inquiries concerning the program to Dr. Henry Eyring, acting director of fundamental research, Textile Research Institute Laboratories, Princeton, New Jersey.

Textile Research Institute, Inc., Has Under Way at Princeton a

Post-War Textile Economic Research Project

The Textile Research Institute, Inc., now has under way an economic research project involving a study of the probable competitive position of the American textile industry in the post-war era, according to announcement by Robert R. West, chairman of the Institute's committee on economic research, and Douglas G. Woolf, director of economic research for the Institute. The project is centered in Princeton under the direction of Prof. A. M. McIsaac, of the Department of Economics, Princeton University. The active direction of the project is in the hands of an executive committee of three, including Dr. McIsaac, Dr. James G. Smith, also of the Princeton faculty, and Mr. Woolf. The project is being financed by an appropriation from the Textile Foundation.

A Textile Economic Research Group has been set up for the purpose of conducting this study. This group will include the executive committee mentioned above; members of the Princeton University faculty in economics and other departments who will conduct project studies; such other staff and representatives of other organizations as may be required for the effective prosecution of the program; and a Princeton Advisory Committee on Textile Economic Research to provide consultation, advice and technical guidance for the project.

The project will be broken down into three phases: (a) an introductory survey of the contemporary position and problems of the textile industry; (b) the conduct of special project studies concurrently with this introductory survey; and (c) the drafting of a final report designed to summarize and emphasize the findings of the various subject-studies. Those findings will be presented in a form which will be useful to the textile industry and to individual companies in formulating their operating policies.

Throughout the entire study, most careful thought will be given to the method of presentation in view of the fact that it is recognized by both the economic research committee and the staff members at Princeton that this is a major consideration in the development of an economic study in an industry.

The study grew out of the recognition of the need for such a project because it is inevitable that the economic problem will be paramount in the industry after the war.

Members of the committee on economic research of the Textile Research Institute, Inc., which approved the project, include: Robert R, West, president, Esmond Mills, Inc.; F. W. Binzen, merchandise manager, J. C. Penney Co., Inc.; Miss Irene L. Blunt, executive secretary, National Federation of Tex-

tiles, Inc.; Flint Garrison, publisher, *Garrison's Magazine*, and former president of the Wholesale Dry Goods Institute; A. Ford Hinrichs, Acting Commissioner of Labor Statistics, U. S. Department of Labor; L. A. Hird, treasurer, Samuel Hird & Sons; Luther H. Hodges, vice-president, Marshall Field & Co.; Stanley B. Hunt, editor, *Rayon Organon*, and president, Textile Economics Bureau, Inc.; Lt.-Col. Stephen J. Kennedy, in charge of the Textile Branch, Research and Development Div., Quartermaster Corps, U.S.A.; H. E. Michl, economist, The Cotton-Textile Institute, Inc.; and Douglas G. Woolf, vice-president, Textile Research Institute, Inc.

Report on Drying of Textiles

A report on "The Drying of Textiles" has been published by the department of information of the Textile Research Institute, Inc., New York. This represents a compilation of the results of a three-year program of textile drying research conducted by the Institute. These results have appeared in various places but have not previously been gathered together in one report. The study was conducted under the direction of an administrative committee for drying research, of the Institute, under the chairmanship of Dr. Albert C. Walker, of the Bell Telephone Laboratories, Inc.

Publication of the complete report of this extensive research is particularly appropriate at this time, since the Textile Research Institute, Inc., has recently started a program involving the study of radiant energy drying, at its applied research laboratories in Princeton, N. J. Consequently the current report may be regarded as foundation reading for those interested in further work on this important subject. At a later date, progress reports on the radiant energy drying study will be published by the Institute and will thus supplement this current summary.

The drying booklet represents a new form of these supplementary reports in that they now correspond to the size of TEXTILE RESEARCH, the official publication of the Textile Research Institute, Inc., and the Textile Foundation. The purpose of this change is to enable members to bind the supplementary reports with their copies of the publication.

This report has been distributed without charge to members of the Institute. Price to non-members is 75 cents per copy.

RESEARCH ACTIVITIES

Honorary membership in the American Association of Textile Technologists has been conferred upon Dr. Harold DeWitt Smith, treasurer of A. M. Tenney Associates. The board of governors of the association recently nominated Dr. Smith for honorary membership in accordance with the Constitution of the A.A.T.T. which provides that a person who has made an outstanding contribution to the textile industry is entitled to honorary membership. Election followed by letter ballot received from over three-fourths of the membership in the association with no dissenting votes cast.

Dr. Smith is a graduate of Lehigh University with a Ch.E. degree and with honors of membership in Tau Beta Pi and Sigma Xi. He was awarded a Ph.D. degree at the University of Berlin in 1930. He is a Fellow of the Textile Institute of England, and has been an honorary life member for the past six years. He is vice-president of the Textile Research Institute, Inc., and a trustee of the Textile Museum in Washington. He is a member of the scientific advisory committee of the Textile Foundation; the Advisory Board, Research and Development Branch, Office of the Quartermaster General, U. S. Army; the A.A.T.C.C.; The Faraday Society and the Society of the Chemical Industry (England). Dr. Smith has lectured in this country extensively and also in England. He has written a number of technical papers, and has contributed to textbooks on textiles. Recently, he was given the honor of delivering the annual Marburg Lecture before the annual (June, 1944) meeting of the American Society for Testing Materials, the subject of his lecture being, "Textile Fibers—An Engineering Approach to an Understanding of Their Properties and Utilization."

Harold DeWitt Smith.

At the December meeting of the association, Dr. Smith will be presented with a plaque bearing the membership inscription. Thus far only two textile men have been elected as honorary members: Ernest C. Geier, president of The Duplan Corporation, and Sir Samuel Salvage, formerly chairman of the board of directors, American Viscose Corporation.

Facilities for training their laboratory workers in the technique of fiber testing are offered as a service to cotton mills by the division of technical service, The Cotton-Textile Institute, Inc. Through a cooperative arrangement with the Textile School at Clem-

son College, Clemson, S. C., a modern cotton testing laboratory has been made available to the Institute. The Institute — Clemson laboratory is equipped to make fiber strength measurements, both round bundle and flat bundle; maturity tests; length distribution with the Suter-Webb Sorter, and the Hertel Fibrograph; and fineness tests. It is believed that this service will offer a solution to the problem of obtaining trained personnel for mills who have established laboratories in connection with their cotton departments and quality control programs. Particulars in regard to this service may be had by writing to John Wigington, director, Division of Technical Service, The Cotton-Textile Institute, Inc., Box 151, Clemson, South Carolina.

The first award of the Olney Medal by the American Association of Textile Chemists and Colorists was made to Dr. Louis A. Olney, for whom the medal was named, at the annual meeting of the association in Atlantic City, N. J., on October 14th. Dr. Olney is Professor Emeritus of textile chemistry and dyeing at the Lowell Textile Institute, Lowell, Massachusetts, having retired as head of that department in June.

Members of the Industrial Fiber Society and guests met in September at the Callaway auditorium in LaGrange, Ga., for the Fall Meeting of the society. The two-day program of papers and informal discussion included the following subjects: Fatigue Testing; Applications of Fibrograph; Notes on Pressley Test; Cotton Breeding and Harvesting; Use of Statistical Methods in Textile Manufacturing; Physical Properties of Fiberglas and its Commercial Applications; Fibers and Contact Pressure Resins; Asbestos Fibers and Yarns; Dimensions in which to Express Textile Properties; and Some Aspects of Cellulose Degradation. The Brownian motion exhibited by particles found in cellulose, wool, and starch shown in moving pictures was a feature of the evening session. One of the features of the meeting was a visit to the Callaway Institute. The Industrial Fiber Society is a professional society to provide meetings for the much-needed informal get-togethers between scientific people of various professions and specialties within the field of research on fibrous materials (See TEXTILE RESEARCH, Page 142, May, 1944).

The American Section of the Society of Chemical Industry has elected Dr. Elmer K. Bolton, Chemical Director of E. I. du Pont de Nemours & Company, Wilmington, Delaware, to receive the Perkin Medal in recognition of his outstanding accomplishments in the field of industrial research. Presentation of the medal will be made at a dinner meeting of the society at the Commodore Hotel in New York City on Friday, January 5, 1945.

Research on laundering of synthetic fabrics is being conducted by the Westinghouse Home Economics Institute. The increase in the use of synthetic fabrics which require laundering methods which differ from those used for cottons and woolens makes this study of especial importance. The study will include research on shrinkage and colorfastness.

Scientist Outlines the Organization, Functions, and Operation of

An Industrial Research Department

By D. E. CHAMBERS*

Of value alike to large and small organizations and to all engaged in the conduct of research, the following article by the assistant director of one of the nation's greatest industrial organizations merits wide attention and study. This paper was presented at a round table conference on "The Role of Technical Research on Product Development," which was held in conjunction with the 262nd regular meeting of the National Industrial Conference Board at the Waldorf-Astoria Hotel, New York, N. Y., September 21, 1944.

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As the basis for this description of an organization of an industrial research laboratory, I shall use the research laboratory of the General Electric Company, not only because I am familiar with it but because the laboratory has contributed since it was established in 1900 significantly to the development of the company and the nation.

The newness of the field of electricity has favored rapid developments and its character has required a high order of technical ability. The company now has more than fifty major lines of products which vary greatly as to type; for example, steam turbines, lamps, electronic equipment. Certain lines are custom lines, others are for the mass markets.

The problem in connection with the management, engineering and development of products is to obtain directness and freedom of action, without conflict. To this end the company is organized as an association of small businesses; each has full authority to carry on its day-to-day work in sales, engineering, engineering development and manufacturing, and is subject to higher executive guidance and check only on broad matters of policy and performance. Manufacturing is carried on in many works, large and small, together with the associated engineering development work. Several diverse lines may be manufactured in one works.

In addition to the various engineering and factory divisions within a works, each works maintains separate inspection and testing divisions and a works laboratory which are responsible to the works manager for the acceptance of incoming material and for the mechanical and performance acceptability of the various products manufactured.

The works laboratory performs service functions as requested by the various divisions, such as laboratory-type tests of incoming material, laboratory tests for control of processes, and cali-

* Assistant to the Director, Research Laboratory, General Electric Company.

bration of instruments. It also carries on developments to crystallize into practical form, for the divisions of its own works, certain new devices, materials or processes based upon research which usually has been carried on by another laboratory.

Although the company's products are diverse in type, many technical unknowns of fundamental character are common to them and basic technical research of broad scope is needed to which in the long run will benefit the whole company. The need is manifest for this research to be not only intensive (applied) but also extensive (basic). To fulfill this need the Research Laboratory was formed.

With engineering development—the seeking of advantage through the application of existing knowledge—which is the responsibility of the operating divisions, the research laboratory—seeking new knowledge for future utilization—was made an independent department. As a separate department acting only in an advisory capacity, the research laboratory can take a more detached view, and can sometimes gain a better perspective of the company's major problems since it is relatively free from commercial considerations and production requirements which in any well-ordered business must take precedence over experimental needs. Further, it has greater mobility. Since it is not tied down to steady responsibilities it can quickly shift its attention and concentrate its energies, and truly emergency problems can be attacked in force.

Leadership

In the work of a laboratory, as in every other organized human activity, the foremost factor in success is leadership. The director's leadership should spring not only from requisite technical knowledge and business judgment, and ability to recognize accomplishments and understand individual problems, but also from a devotion to scientific truth and an infectious enthusiasm which transmits itself to others. Then an esprit de corps is inevitable and will enforce success when success is at all possible.

The spirit of a laboratory should be the spirit of teamwork. In some of the early German laboratories and indeed in some of the laboratories of this country, secrecy and what might be termed the "compartmental plan" prevailed. Each man worked behind locked doors and only the director knew what each was doing. Such a system forfeits the greatest advantage an organization should have over an individual worker, the cumulative factor of teamwork. If each man's knowledge is freely available to all the others, the total output should rise not in arithmetical proportion to the number of workers but in some geometrical ratio.

No plan or system can displace leadership in fostering teamwork, but there are things that can help or hinder its growth. Everything is helpful that serves to accentuate the community of interest of the whole staff, to foster a free interchange of ideas, or to subordinate selfish individual interests. Frequent group meetings of those working on similar or related problems are desirable to report progress and to elicit discussion and suggestions. Informal consultations should be encouraged, and each man taught that when his work leads him on to ground unfamiliar to him and better known to

some other member of the staff, he should promptly seek the other's advice or help. Thus thoroughgoing team play is achieved.

Recognition

Bonuses for inventions and other conspicuous recognitions of individual achievement should be awarded sparingly, if at all, for they may be conducive to secretiveness and jealousy and destructive to teamwork. Bonuses may also be unfair, in that researches or developments of equal importance and requiring equal abilities for their successful conduct may be very unequal in the opportunities they offer for invention. Work in any new field is practically certain to result in many patentable inventions, while the chance of invention is comparatively small in a field which has been intensively cultivated. Meritorious work should usually be recognized in salary alone. If a company's policy includes a profit-sharing bonus, the share should be largely based on the contributions of the whole department to the company's welfare, and the relative amounts of the individual payments should not materially distort the salary scale.

The chances for a research man to be placed in charge of a sizable group are very much smaller than for a man of comparable ability who works in an engineering department. Further, what may be brilliant research may seem for extended periods to yield little in the way of tangible results, whereas most engineering endeavors may be judged over relatively short intervals. Thus, compensation should be based on the contributions of the researcher over a substantial period relative to his opportunities.

The laboratory organization is based on the group system, with each group built around and directed by one of the abler and more experienced men. The best size for each group depends on the characteristics of its leader, but is generally small. Some of the ablest research men have single-track minds and are at their best when they can concentrate exclusively on a single problem. Such a man can advantageously direct only as many assistants as can be effectively utilized on the problem at hand. Often the most useful assistant is one who is adaptable or receptive rather than one possessing great originality and aggressiveness. A research man is only rarely found with mentality sufficiently detached and versatile to be able to direct and contribute effectively to a number of simultaneous researches. Such a man can successfully supervise a large group or several groups, and the more originality his assistants possess the better.

The director of the laboratory should have full authority in the choice of problems, for he has the responsibility for the laboratory's success. The wise choice of problems is one of the two controlling factors in that success; the others the ability with which the chosen problems are attacked. He will be able to trust most of the heads of the research groups to select the problems in their special fields wisely and he should simply encourage the exceptional research men to work on the problems in their fields that interest them most. The director should obviously have full information of his company's plans and outstanding commercial, technical and manufacturing needs, and adequate chan-

nels for such information should be provided. Usually, the director should be an officer of the company to insure close contact with company policies and clear understanding by the management of his aims and methods.

Financial Returns

It is not to be expected that research will yield immediate financial returns. Some investigations have been continued and have cost hundreds of thousands of dollars before ultimate success was reached and liquidation of the expense through profits begun.

Neither is it to be expected that every research will prove profitable. In fact, unless the experimental failures outnumber the successes, one may usually conclude that little real research work is being carried on. In most investigations it becomes necessary in time to decide to abandon them. Knowing when to stop is next in importance to knowing when to start. Many a laboratory has had experience with a line of research work which continued so long, with constant promise of success but without ever reaching it, that the wisdom of its discontinuance became a perennial question. Perhaps the best criterion is to forget the past labor and expenditure and to ask oneself whether, with one's present knowledge, the problem looks so promising that one would initiate its investigation were work on it not already in progress. If the answer is "No," then the work should be promptly discontinued, for in research, as in other ventures, it is folly to throw good money after bad.

The successful researches must pay for the failures, and in general this is possible only through the patent protection obtainable on new developments. Were it not for the patent system, most of the urge for an industrial concern to maintain a research laboratory would not exist, for no corporation however wealthy could afford much of the great expense of research if its results, soon after they were commercially developed, could be copied by competitors at the bare cost of reproduction. To obtain patent protection, adequate laboratory records must be kept. Many laboratory workers tend to forget that a patent interference, determining the rights to an important invention, may be won or lost on the adequacy of laboratory records, and they tend to forget that the full significance of day-to-day results may not be realized until much later. A research man who fails to make such records of his work is as faithless to his employer as a hired mining prospector would be if he became so interested in his valuable discoveries that he omitted to stake out his claim.

Laboratory records should include both original data and reports. Original observations should be entered daily in a notebook or log, duly dated and witnessed. This is the primary record. But that record may usually be clarified and strengthened by periodic reports summarizing the progress of the work.

While the preparation of reports is irksome to most research men, the privilege of writing papers for presentation before scientific and technical societies is usually eagerly sought, and should be actively encouraged by the laboratory management. At times commercial or patent considerations dictate a delay in publication, but, subject to such reasonable postpone-

ments, the laboratory should insist on a corporate policy of free publication of laboratory results. Nothing less is fair to the research workers. They should receive great good from contact with their fellow members in the technical societies, but they cannot expect to receive without giving, and their standing with their fellows is measured by the worth of their contributions. In consequence no laboratory deserves or should expect to retain the best men if it does not make it possible for them to receive, through publication of their work, the recognition in scientific or technical circles that is their due.

Facilities

Of prime importance to a research laboratory are adequate facilities. These should be provided with the objectives in view of best utilizing the time and energy of the research workers and of providing them with the best available means for extending the frontiers of their knowledge.

One of the facilities is a good library. It is one of the essential tools that will be much used if it covers broadly the technical field.

A laboratory should be located as close as possible to the factory or factories it serves. Proximity promotes understanding of factory problems, facilities the investigation by the laboratory of factory processes, renders the factory facilities conveniently available for the making of certain special apparatus for laboratory use and for trying out laboratory findings on a semiproductive scale. Proximity invites recourse to the laboratory by operating personnel for help with their problems.

But as far as possible the laboratory should be self-contained with respect to its shops. Further, the laboratory shops should be operated so that the needs of the research men are promptly satisfied. The need is to speed up the research, to utilize fully the comparatively rare creative abilities of the research men and to obtain results which may be marketed more quickly.

The laboratory should be self-supporting as far as accounting can make it so. That is, the laboratory expenditures should as far as possible be assessed against the cost of the specific apparatus that benefits from the work, and liquidated in factory cost of that apparatus, rather than carried as an overhead expense of the company. This insures that more nearly the true cost picture is provided for each product. Direct allocation of laboratory charges is helpful to the director as a continuous check on the economic justification of each line of work. If the department receiving the charges accepts them cheerfully, it is assurance that the expense of that investigation is well justified.

Every laboratory should operate on a budget system. Too much itemization of the research work should not be required, however, because as initial work progresses, far greater possibilities may be revealed than could possibly have been foreseen and substantial expansion of the work may be warranted, or, it may prove disappointing and lead to a total cessation of the investigation in its early stages.

Research to Reality

The methods of insuring the prompt introduction of laboratory results into factory process or product are impor-

tant considerations. In companies where the director of research is also chief engineer, the matter is simple. Laboratory findings may immediately be translated into technical instructions, binding on the factory. But the General Electric Research Laboratory is an independent department and therefore it is to be expected that the problem is sometimes more difficult, particularly when something radically new in process or product is involved. In fact, salesmanship is often necessary. But just as any salesman's job is easier if he thoroughly understands his customer's problems, has kept him informed of developments which may affect his product and market, and has built up respect for his own ability, judgment and integrity—so the laboratory's sales job is made easier if it follows the same policies. This means that laboratory personnel should be members of the appropriate company technical committees, and should welcome and seek opportunities to act as consultants, that the laboratory should act as a training ground for certain of the company's technical personnel and that laboratory reports should reach the appropriate groups in the operating divisions. It means that the laboratory's work is appropriately geared to the company's long-range program.

Of great aid in connection with the introduction of processes and certain new products are the various works laboratories which, are often willing and able to take research results and quickly translate them into forms usable in the operating divisions. And similarly, the engineering development groups are generally receptive.

Several means are used for initiating transitions. The office of the research laboratory's executive engineer has the responsibility of being familiar with the company's organization, facilities and principal personnel on the one hand and with the research projects and their status on the other. He has the responsibility of initiating recommendations that projects be taken up by another division of the company and be terminated in the Research Laboratory.

The executive engineer is aided in this work in various ways. For example, several of the operating departments of the company have divisions which are responsible for the sale of laboratory or miscellaneous products in the fields of their departments. The work of these divisions brings their members into close touch with the research and other laboratories. Through these contracts, these men become familiar with the products and by-products of the work of these laboratories and are then able to visualize the applications to the problems of their customers. When an application becomes apparent, action is taken to interest the appropriate engineering and manufacturing divisions.

However, should transitional channels fail, it may be necessary for the laboratory not only to embark on the engineering development of its research results but even to manufacture for a time in small quantity to demonstrate the merits of its product. Such manufacturing may be carried on within the laboratory itself, if the necessary facilities can be provided economically, or the laboratory may temporarily take charge of a section of a factory department. Our laboratory has on various occasions resorted to each of these measures.

Quality of Staff

Good researchers seem to be born, not made. First-class research men are much rarer than first-class engineers. Research and engineering require different aptitudes for success, and the mental attitude required is wholly different.

The successful engineer is the type that likes to deal with certainties, to utilize materials whose properties he knows and has confidence in, and to produce from them concrete results in new structures, new devices. For economic reasons, he must be a devotee of standardization. Optimism and imagination are of value to him, but they must be sternly ruled by sound judgment. The engineer's mistakes, like the doctor's, may be disastrous to others, but since, unlike the doctor, he cannot bury them, they are disastrous to the engineer himself.

On the other hand, the research man has outstanding scientific curiosity and is primarily interested in the unknown. He seldom has the patience to carry a new idea through to a finished design. The exceptional is an inspiration to him and when he finds it he seeks to develop its peculiarities to the fullest extent. The research man's imagination should be of the philosophical type to enable him to coordinate his observations into hypotheses for experimental verification or disproof. There is no vocation in which optimism is more essential than in research; it is easy to think of many reasons why a proposed experiment would be futile, but the man who makes the discoveries is the man who goes ahead and tries it just the same; optimism is to research what vitamins are to the animal organism. Of course, there are more common virtues such as intellectual honesty, clear thinking, industry, resourcefulness, and perseverance, which should be possesed by both the engineer and the researcher. What I have tried to do is to bring out those features which distinguish the true research man from the successful engineer.

National Profits

Research as a part of the General Electric Company's activities has been thoroughly justified. It has provided much of the new knowledge from which new products have grown and from which the old have been made better and less costly; and because it is an integrated part of the company's activities, the benefits of the results of research have the more quickly been made available to the public.

Whatever profit a corporation may make from any successful research, the public always gains far more. As examples, consider the far-reaching benefits of the incandescent and fluorescent lamps and the hermetically sealed refrigerator. The purchasing public profits directly, while the whole nation's business profits indirectly in peacetime by the strengthening of the position of American industry in international competition. And it is in a large measure because of the strong position American industry has achieved in international competition that victory will be achieved in this war.

Photomicrography of Textiles For Legal Purposes

By MARTIN H. GURLEY, JR.*

In the following article there is demonstrated clearly the principle of the use of "activating" or cementing fibers in a yarn which is woven into the bonding layer of a sandwich of fabrics in the construction of a fused collar.

★ ★ ★

Photomicrography, the science of photographic reproduction of images which may be seen through one or another of the various types of microscope, is almost as old as photography itself. Its recognition as a legal means of presenting evidence is also old. The use of photomicrographs in court is generally preferable to the use of a microscope itself, since photomicrographs properly enlarged may be seen by all in the courtroom at the same time. Such photographs, of course, can be verified by observation through the microscope.

Although photomicrographs cannot replace the article itself, for example, textile fabrics in dispute, they do nevertheless serve to clarify and present in a proper light the points in discussion. In addition, they serve as a permanent record of any observed conditions which may be fleeting or which may change through handling of the material photographed. This is often of great importance where the litigation may extend for a year or longer. Enlarged photomicrographs also serve to bring to a size suitable for observation, objects and points which may be very difficult to observe in their normal size.

It should be emphasized that photographs for legal purposes must be identified by qualified witnesses and, where possible, the subject of the photograph must be preserved in a state such that it is submissible as evidence.

Groupings of photographs to illustrate a change in process, or a series of events in evidence is proper and groups of photomicrographs are also admissible as evidence. This makes it possible to show in such an assembly a complete series of process steps and their effects on the resulting product.

One objection to ordinary photographs is that they do not bring out the perspective or three-dimensional space relationship of the various components of the subject photographed. Where only moderate magnifications are involved this objection can be overcome by using the technique of stereoscopic photographs which, when viewed through a stereoscope, show the article with the same "depth" or perspective as it would have if viewed with the naked eye. This requires a very special technique but is very effective in many cases. It is even possible to project such photographs onto a screen in the courtroom if desired.

* Gustavus J. Esselen, Inc., Consulting Chemists and Chemical Engineers, Boston, Massachusetts.

Photomicrography of textile products, or textile micrography, is a small section of the science of photomicrography. The techniques are not new and have been adequately described in such volumes as "Textile Microscopy" by Lawrie, 1928, and "Textiles and the Microscope" by Schwarz, 1934. It is often used for legal purposes.

Suitable photomicrographs require extreme care in selection, preparation and illumination of the subject to insure representative reproductions of the material. The ingenuity of the worker is an important tool for the proper presentation of evidence seen through a microscope. An accurate record should be made of all steps in the preparation of the photomicrograph, including particularly the identification of both the sample and the portion photographed. It should detail the illumination and lenses used, as well as film and exposure time.

The results of applications of some of these techniques are shown in the accompanying illustrations.

These photomicrographs were made to demonstrate in court the changes taking place in fabrics during the production of a fused collar. Figure 1 is a filling-wise cross-section of the fabrics composing the sandwich. The cementing acetate fiber in the bonding layer has been stained to emphasize its highly looped path through the fabric. Figure 2 is a surface view of the bonding fabric. The staining of the ace-

Fig. 1. Cross-section filling-wise of three layers of fabrics before fusing in the manufacture of a fused collar. The cementing acetate fiber in the bonding layer has been stained.

tate yarn emphasizes the relatively small amount of potentially cementious material needed for the production of the fused collar.

Figure 3 is a cross-section of the completed collar. It is evident that the continuity of the acetate yarn has been destroyed. Little evidence of it is visible in the photograph, for it has flowed throughout the structure and has cemented the three layers of fabric into one shaped mass which still has the outward appearance and porosity of the sandwich of the original textile, but is quite stiff and without drape.

These pictures show what happens in the manufacture of a fused collar in a manner such that it may be explained easily to a group of persons at one time. To demonstrate this under a microscope would be difficult and would entail repetition of explanation or a multiplicity of microscopes and cross sections. In addition, these photographs may be marked with arrows to emphasize important points.

The cross-sections used for these illustrations were prepared by placing the fabric to be sectioned between two pieces of plane-edged glass. The fabric was then moved up to a point at which the acetate yarns would be just below the level of the glass edge. This was done by inspection with hand glass. The acetate yarn was essentially parallel to the plane edge of the glass, the two pieces of glass were carefully clamped together in a small hand vise and then a microtome blade was run along the glass, using the plane edges as a guide. The resulting exposed

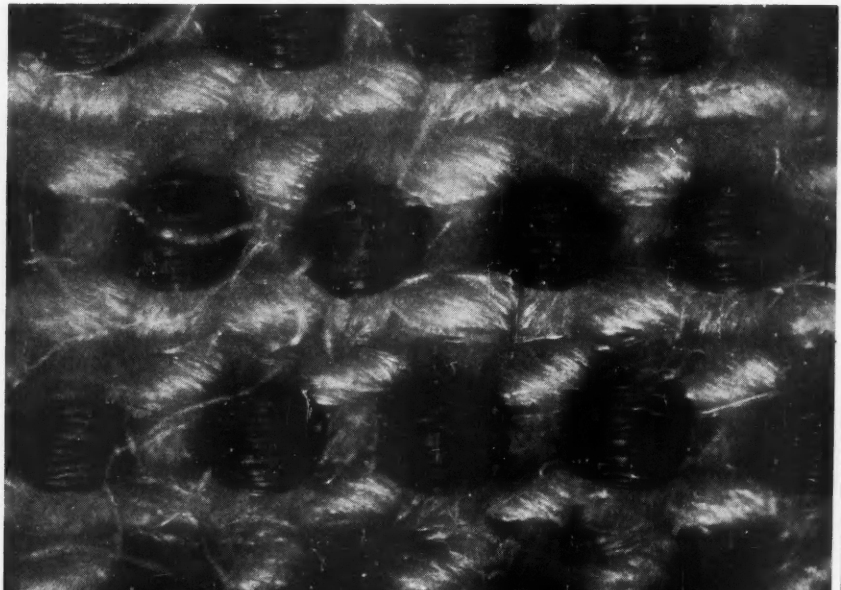

Fig. 2. Surface view of the bonding layer before fusing.

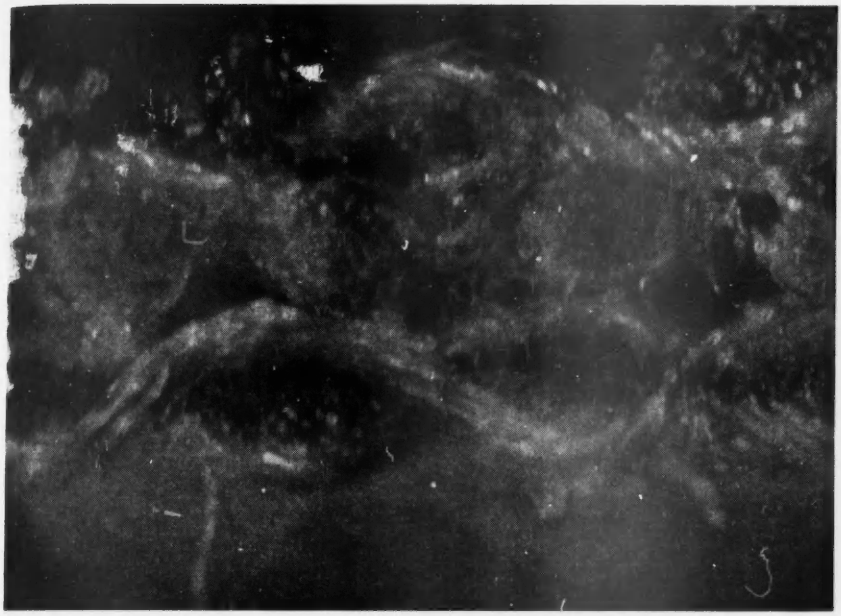

Fig. 3. Cross-section of the completed collar.

section was first examined under a hand glass and when found satisfactory was photographed. The pressure on the holding glass was slightly released just before photographing to allow the three fabrics to spread apart, as in Figure 1.

The sectioned fabric was surface-lighted and photographed through an objective in a 5 x 7 view camera. Film was used and the negatives were projected for the enlarged 11 x 14 positive prints. This resulted in a magnification of 330X.

Control of Wool Shrinkage

A process for stabilizing wool and wool blends without affecting the absorbency characteristic of wool has been used successfully by a number of leading finishers, according to the Calco Division of American Cyanamid Co. It is said to reduce felting and prevent piling and fuzzing, and to impart a much higher resistance to alkali than is present in untreated wool. The method employs a new melamine resin marketed under the name Lanaset.

Effects of Stripping on Card Sliver Size

By C. H. PLUMMER

A Contribution of the Research Division, Chicopee Mfg. Corp.

For satisfactory operation of the cotton card, it is necessary to strip periodically the wire of the doffer and the main cylinder. This stripping operation removes the fiber embedded in the card clothing and on resuming production part of the cotton fed to the card goes to the cylinders, consequently producing a light sliver for a short period of time. By means of the Saco-Lowell Sliver Tester, it has been possible to measure this light sliver and thus experimentally determine the amount of time required for the card to reach its normal operating condition after stripping.

Samples of sliver were obtained during the stripping cycle from a card known to be in satisfactory operating condition. Part of the samples were taken immediately after stripping without the usual run-out period and the balance of the samples were obtained using the normal method of allowing approximately one minute of run-out before piecing up the sliver after stripping. These samples were analyzed on the Saco-Lowell Sliver Tester and graphic charts were made using a chart speed ratio of 1728 : 1.

Figure 1 illustrates a typical sliver made without any run-out period after stripping. The average size and percent standard deviation were computed for the consecutive lengths of sliver as indicated on the chart. The graphic chart illustrates clearly the size and amount of light sliver that is produced immediately after stripping. From the chart it was determined that this "building up" period lasts for approximately one minute of operation of the card when running at ten pounds per hour. The sliver immediately after stripping starts with a size of approximately 38 grains per yard and builds up in weight during the first minute of operation to nearly the average value of 50 grains per yard. Judging from the samples taken before and after stripping the average size after stripping is reduced approximately 3 percent. This reduction in size is insignificant considering other short period variations in linear density present.

Figure 2 illustrates a typical record of a sample of card sliver made with a one-minute run-out period before the sliver was pieced up after stripping. In this record the section of very light sliver, of course, has been eliminated. This particular sample of card sliver was taken from a section of the lap which apparently had a considerable amount of linear density variation. For this reason, the reduction in average size, indicated on the sample in Figure 1, has been somewhat masked out. From these results the one-minute run-out period would appear to be sufficient to eliminate any significant amount of the very light sliver produced immediately after stripping.

Aside from the effects of stripping illustrated in these charts, the different linear density characteristics of the lap are prominent. The irregu-

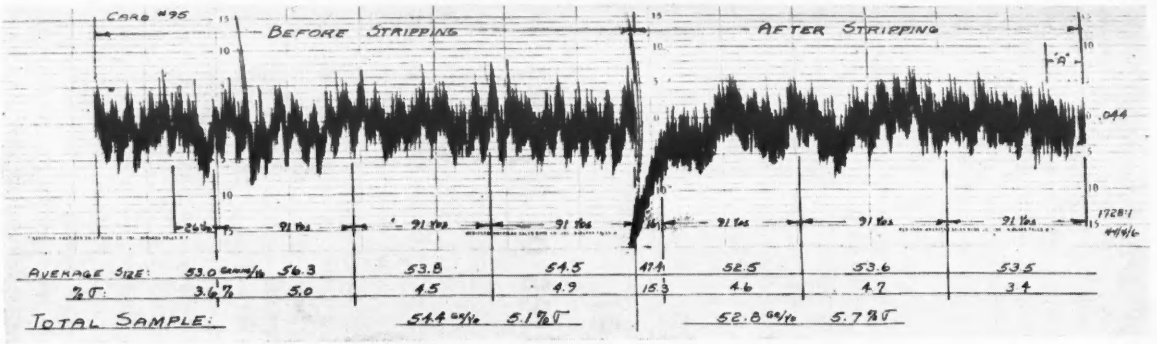
CARD #95
BEFORE STRIPPING
AFTER STRIPPING
"A"
.044
1728:1
AVERAGE SIZE: 53.0 grains/yd. 56.3 53.8 54.5 47.4 52.5 53.6 53.5
% U: 3.6% 5.0 4.5 4.9 15.3 4.6 4.7 3.4
TOTAL SAMPLE: 54.4 gr/yd 5.1% U
52.8 gr/yd 5.7% U

Fig. 1. Sliver taken without any run-out period after stripping.

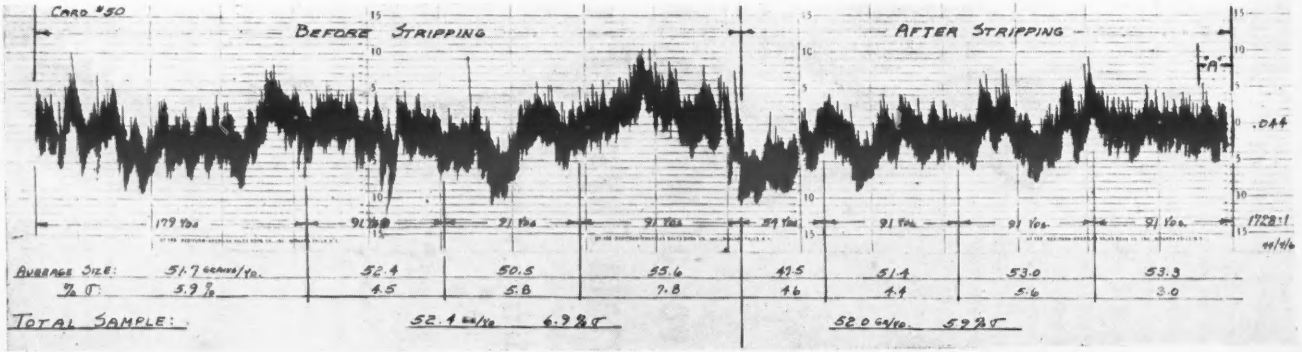
CARD #50
BEFORE STRIPPING
AFTER STRIPPING
"A"
.044
1728:1
AVERAGE SIZE: 51.7 grains/yd. 52.4 50.5 55.6 47.5 51.4 53.0 53.3
% U: 5.9% 4.5 5.8 7.8 4.6 4.4 5.6 3.0
TOTAL SAMPLE: 52.1 gr/yd 6.9% U
52.0 gr/yd 5.9% U

Fig. 2. One minute run-out before piecing up sliver after stripping.
"A"—One minute of card sliver at 10 lbs./hr.

larities illustrated in Figure 1 have a short period in contrast to the long period variations of Figure 2. From previous work it has been found that short period variations are mainly due to poor sheet forming in the picker and the longer period variations are usually traceable to defective evener motion action.

To review the results of this work it appears that approximately one minute of operation is required after stripping the card before piecing up the sliver to eliminate the sections of light sliver produced immediately after stripping. By this procedure the reduction in size is negligible and far less than some of the other causes for linear density irregularity.

Acknowledgments

The author wishes to acknowledge the assistance of Miss Alice Kane and Miss Alta King, laboratory assistant and secretary respectively, in the compilation of the data and the preparation of the report.

(In an early issue of TEXTILE RESEARCH there will follow a paper describing the use of condensed sliver test records and methods for interpretation of the data. *Editor.*)

Effect of Wet Finishing on Certain Physical Properties of Nylon

By WALTER J. HAMBURGER*

That the finisher can alter the physics of fabrics for better or for worse has been stressed many times. After all is said and done, he has no product or commodity to sell, he sells consumer satisfaction and that satisfaction will be governed by his knowledge of new fibre properties to an ever increasing extent in the immediate future and in the years that lie ahead.

* Fabric Research Laboratories, Inc., Boston, Massachusetts. Abstract of paper winning second award in the intersectional contest held in connection with the annual meeting of A.A.T.C.C., October 13, 1944.

Many of the physical properties of nylon are affected by wet finishing, but in the ten minutes allotted me, it is impossible to discuss all of them. I have therefore selected a few which should be of the most general interest at this time, and I shall try to hit the high spots of these.

THE NORMAL REGAIN OF NYLON which has never been subjected to wet treatment is 3.5% ±. If, however, it is wet out in water and allowed to condition, its regain is increased. If it is then bone dried and reconditioned, its regain is less than after wetting and conditioning, but more than its normal. On ensuing repeated bone dryings, the regain remains essentially constant;

but at a value higher than its normal regain at 70° F and 65% R. H.

THE HANDLE OF FABRICS. How can we improve the crush resistance of, let us say, nylon fleeces, pile fabrics or velvets? By treating a nylon fleece with steam, its resistance to compression is increased and its recovery is improved. Thus, wet finishing can enhance the utilitarian value of the material.

DURABILITY is also a property over which the finisher may exercise control. Increases in wear resistance of as much as 50% may be accomplished by simple immersion in water at elevated temperatures or by steaming. The rate of destruction is likewise decreased by such a finishing technique.

NYLON HAS AN UNCANNY MEMORY for what has previously been done to it; but fortunately it can be made to forget, when necessary. The sailor depends upon a sequence of events to make his decisions:

"If the rain before the wind
Halliards sheets and topsails mind
If the wind before the rain
Hoist your topsails up again."

The wet finisher can also depend upon a sequence of events to make his decisions. By treating nylon at elevated temperatures followed by treatment at lower temperatures, the effect of the first treatment will prevail. Nylon remembers! However, if the earlier treatment is the lower temperature followed by higher temperature, the latter will cancel the effect of the former. Nylon forgets! Nylon's early history must be known and accounted for if results are to be successfully predicted.

If a portion of a nylon fabric which has been steam treated is dyed in the same bath with a portion which has not been treated, and the temperature of the dye bath is carefully controlled at, let us say, 180° F, the treated portion will dye a deeper shade. The shade difference is apparent from visual observation as well as from spectrophotometric curves. It is thus evident that even with carefully controlled dyeing conditions, memory plays an important part in the results obtained, and must be carefully considered if streaks, bands, etc., are to be eliminated. The finisher can guard against such defects. He has three alternatives: (1) All wet treatments of yarns and fabrics prior to dyeing may be controlled to insure uniformity; (2) Dyeing may be carried out at a temperature higher than was experienced in any previous treatment; (3) Before dyeing, the material may be immersed in water, or be steamed, at a temperature higher than any previous treatment.

HIGHER IMMERSION TEMPERATURES have no significant effect upon strength; but the elongation is definitely increased with increases in immersion temperature. Energy absorption may be increased 50% or more by wet finishing. This is extremely important in fabrics which may be subjected to shock loading as in the case of parachute canopy fabrics and shroud lines. Apparel textiles are also subjected to suddenly applied loads in the form of snags, rips, tears, and jerks.

Dimensions for Expressing Strengths of Textiles

By S. L. GERHARD *

Two of the most important items in any technology are the terminology and concepts employed in expressing the results of observations. As textile research is just now beginning to develop along more rigorous and profound lines of thought it is appropriate and salutary that some consideration be given to the words and concepts used in exchanging ideas. The purposes in examining our terminology are first, to simplify it wherever possible, eliminating unnecessarily cumbersome and round-about terms; and second, to make it more accurate and pertinent to the problems in hand, in order to expand intelligently the applications of textiles.

In the science of measurement there are recognized two distinct sets of concepts, namely, dimensions and units. The dimensions are the more or less intuitive things, like length, force, and time, and several derived dimensions such as density and force per unit area. Units, on the other hand, are the standards adopted for assigning numbers to observations involving these dimensions. We wish to discuss the dimensions, although we will mention the units in illustrating certain points. This distinction is emphasized in order to eliminate arguments over the relative merits of English and Metric systems, which is a subject for debate elsewhere.

For many years the textile industry has been using some method for "correcting" actual strengths for deviations of size from some desired standard. This has often taken the form of a "break factor," which is strength times size. More recently unit strengths and stresses have become recognized as important factors in textile technology, and many different combinations of units are used in expressing them and the break factors. This profusion of derived units for expressing a simple property of material hampers the exchange of ideas necessary for technical progress. The first step in this discussion is to demonstrate the single underlying concept behind these expressions, and to suggest that they be simplified and standardized.

The break factor is generally defined as the strength of the specimen multiplied by its size. The dimensions of this combination are $F \times L/F$, or force times length divided by weight.[1] This reduces to L, which may be called the maximum length. The physical significance of maximum length is that this length of material if freely suspended will be just heavy enough to

* Supervisor Physics Research, Textile Division, U. S. Rubber Co., Hogansville, Ga. Paper presented at meeting of Industrial Fiber Society, LaGrange, Ga., Sept. 23, 1944.

[1] Weight has the dimensions of force, hence F is used to represent both concepts.

break off of its own weight.[2] It is thus evident that break factor for all practical purposes has the dimension of length, and represents the maximum length.

The unit of length in which the break factor or maximum length appears is that used in expressing the size of the material being tested. Thus, lbs. × yds./lb. = yds.; lbs. × cut = number of 100-yd. lengths (cut = 100 yds./lb.). The same is true of the figures obtained when direct units are used for size instead of indirect units. Thus, grams/denier = grams/grams/9000 meters = number of 9000-meter lengths; grams/grex [3] = grams/grams/10^4 meters = number of 10,000-meter lengths; lbs./poumar [4] = lbs./lbs./10^6 yards = number of million yard length, etc. The unit for strength must be converted to the unit of weight used in yarn size if it is not already in that unit, but this is a simple conversion.

When using break factors from skein strengths the number of strands supporting the load has to be considered. A 120-yard skein wound on a reel 1.5 yards in circumference contains 120/1.5 = 80 turns, and when this is placed over the spools of the testing machine 2 × 80 = 160 strands support the load. The break factor reduced to one strand would in this case be skein strength in lbs. × (yds./lb.)/160. This conversion produces a number comparable with those obtained from single and breaks. This number is theoretically comparable, in the sense that it has been reduced to the value that would be true if all the strands supported the load equally, and broke simultaneously. It is well-known that this is not true because a few weak strands break first, resulting in a strength figure which is lower than that obtained in single end tests. This point is mentioned because skein breaks are still widely used in textile testing, and it may in some instances be desirable to compare results with those from single-end tests.

Use of Simple Length Units

It is thus seen that all these different expressions for a sort of "unit strength" of yarns and cords have one and the same dimension, namely length. Would it not be simpler then, to employ familiar length units, such as yards or kilometers instead of the somewhat abstract terms of "break factor" (units frequently not stated), "grams per denier," "grams per grex," "pounds per poumar," or some other logical but round-about combination of units and dimensions? It is suggested that all investigators adopt this simplified nomenclature, in order to simplify the exchange of ideas and accelerate technical progress.

A common objection raised to the use of simple length units, such as yards, for expressing maximum length or lbs./sq.in. for unit strength is that the numbers come out with 5 digits in front of the decimal point, and are inconveniently large. This is a rather trivial objection, especially for those engaged in research and development, and can easily be circumvented by adopting as units kiloyards or kilometers and kilopounds, as the mechanical engineers have done for many

[2] The tension produced at a point in a long piece of yarn suspended vertically is equal to the weight of the material below the point. This weight is equal to the length of the yarn times the weight (not the mass) per unit length.

[3] A. G. Scroggie, *Rayon Textile Monthly*, Jan., Feb., Mar., 1944.

[4] S. L. Gerhard, *Rayon Textile Monthly*, Aug., 1944.

years. The metal and building industries have used equally large numbers in expressing the strengths of their materials, and have not evaded them. Judging from their technological progress, these large numbers have not been a serious hindrance. The textile industry itself might make better progress than in the past if it would likewise employ simple and familiar dimensions and units.

The next step is to show that this maximum length must be further modified before it can be used in investigating the strength characteristics of yarns and cords along conventional lines. It has been demonstrated by many years of experience in studying the strength of materials that force per unit area is the fundamental factor in design for strength. The maximum length now quoted as the final figure in yarn analysis must be converted into strength per unit area by multiplying it by the density [5] of the material. Dimensionally we have $L \times F/L^3 = F/L^2$, which is force per unit area. For example, yds. × (lbs./cu. ft.) × 3/144 = lbs./sq. in.

Effective Density

The significance and interpretation of the number obtained will depend upon what density is used. There are at least two densities from which to choose. One is the density of the filaments themselves, and the use of this figure will express the unit strength in terms of the cross-sectional area of the material supporting the load, not including the air spaces between the filaments. The comparison of different yarn and cord constructions when using this density is on the weight basis, regardless of the volume occupied. Inasmuch as the filament densities are nearly equal for most textiles, the use of break factor, grams per denier, etc., is equivalent to working on this basis. The industry has been using this concept without stating it, or possibly even realizing it. However, some newer textile materials, like glass and asbestos, have much greater densities than other textile materials, and in making comparisons involving them the density factors must be used, if the comparisons are to be valid.

The other principal choice is that of yarn density. This requires the measurement of gauge or yarn diameter in addition to the conventional size measurements, and is consequently convenient for only plied and cabled constructions where gauge measurements are routine practice. Use of this density will express the unit strength in terms of yarn cross-section, and inasmuch as it includes the air-spaces between filaments it will in general be less than that calculated from filament densities. This is the volume basis for comparing strengths when it is desired to pack as much strength as possible into a small volume, as in the case of tire cord and parachute harness.

The actual calculation of unit strength on the volume basis can be made directly from strength and gauge measurements. If we assume that the yarn or cord cross-section is circular and let G equal the gauge or diameter, then strength/$\pi G^2/4$ = strength per unit area, and this involves no other factors, such as grams per denier, maximum length, break factor, or density.

These two bases for expressing unit strengths are both important in practical applications. Both of them should be given when reporting the results of

[5] Here again we mean weight, not mass, per unit volume.

investigations on mechanical fabrics, in the same way that gas engines are rated on horsepower per lb. and horsepower per cu. ft. of fuel. These two ratings of yarns and cords are important to the consumer, and might even be important to the manufacturer himself in his endeavor to meet consumer demands, or to improve the quality of his product. They will certainly help to expand the applications of textiles into new fields, where these properties are comprehended and appreciated.

Factors Affecting Accuracy

In closing this discussion it will be appropriate to mention briefly the accuracy of the figures obtained by the afore-mentioned observations and calculations. Objection has been raised to the idea of expressing yarn strength in terms of force per unit area because of the difficulty in determining accurately the cross-sectional areas of textiles, and because of the great variation of this cross-sectional area. It should be evident from the above discussion that this objection applies equally well to the figures now submitted for grams per denier and break factor. These figures involve size measurements, and the act of combining strength and size factors into one number representing maximum length (break factor or grams per denier) involves implicitly the assumption that the yarn is perfectly uniform in size throughout a length equal at least to that in the skeins weighed in determining the size. Investigations have shown that yarns and cords break at the thinnest segments of the specimen. As these segments are only about an inch long, it is fairly obvious that the size obtained by weighing 12 or 120 yards is not representative of the cross-section of the material in these short thin segments which govern the strength. The accuracy of conventional figures for break factors and grams per denier is thus limited by the accuracy of the size and gauge measurements in representing the cross-sectional characteristics of the materials at the thin segment where they fail in the strength test, and the same statement holds true for any figures calculated from them. The above objection thus applies to our present practices, and our future practices in this regard will be no less accurate, hence the objection should be interpreted as a criticism of present practices, and not as a deterrent to improved terminology and concepts. The objection is absolutely valid; the only excuse for the present practice in this respect is that the textile industry has to compromise between accuracy and the cost of testing a very non-uniform material.

One procedure that might be adopted to increase the precision of our figures is to take into account the decrease in cross-sectional area of the material at break. In the metal industries and in most fundamental research on strength of materials this factor is included in determining unit strength at rupture. In textiles this would amount to a considerable increase in unit strength, because of the relatively great elongation of most textiles. The elongation can be used on the weight basis because the volume of the filaments is approximately invariant, and their total cross-sectional area decreases percentage-wise to the same extent that the length increases. But on the volume basis it may be erroneous to use elongation because the cross-sectional area of the

yarn may decrease considerably more than the length increases. That is, the filaments may be pressed together more tightly than when under no tension, thereby increasing the yarn density. The investigation of these doubtful points might produce valuable information regarding the phenomena associated with the breaking of yarns and cords. The elongation of a 10-inch test specimen is the sum of the elongations in all the infinitesimal lengths, and like the size estimate, does not represent the probably greater elongation in the short thin segment where the break occurs, but its use in calculating unit strengths might be a step in the right direction.

The variation in cross-sectional area or in diameter is large for most yarns made from natural fibers. It has been observed to range from $\pm$ 20 to $\pm$ 50% of the average value. A little evidence is becoming available to indicate that synthetic and regenerated materials produce more uniform yarns. This might be considered as a challenge for cotton mills to spin more uniform yarns if they wish to compete successfully with these new materials. The practical and monetary importance of increasing yarn uniformity is thus apparent.

As an example illustrating the procedures and terminology described above, the following data for a fictitious cotton cord are used:

Strength	17.6 lbs.
Elongation at break	11.2 %
Size	1075 yds./lbs.
Gauge	0.0305 in.
Filament density..	94.5 lbs./cu. ft.

Maximum length: $17.6 \times 1075 =$ 18,920 yds.

(a) Unit strength on wt. basis:
$18{,}920 \times 94.5 \times 3/144 = 37{,}220$ lbs./sq. in.

(b) Unit strength on vol. basis:
$17.6/\pi \times (0.0305)^2/4 = 24{,}080$ lbs./sq. in.

Correcting for elongation at break by multiplying by 1.112 produces 41,400 and 26,800 lbs./sq. in. respectively for the two estimates of unit strength, if such correction is necessary in practical applications.

Summary

It is shown that break factors, grams per denier and similar combinations of strength and size have the simple and familiar dimension of length and this particular length has been called "maximum" length. In order to obtain estimates of the strength characteristics of textiles that are comparable with conventional estimates for other materials, the maximum length must be multiplied by filament density to get strength per unit area on the weight basis. Or the strength may be divided by the yarn cross-sectional area to get strength per unit area on the volume basis. Both these expressions have practical importance and should be reported. The accuracy of any estimate of unit strength is limited by variations in yarn diameter, which are relatively great. Improvements in uniformity will increase the accuracy of these estimates, and at the same time will increase the value of the material. It is hoped that these remarks will help in guiding textile research into increasingly useful and profitable channels.

The criticisms and suggestions received from colleagues in discussing this subject are gratefully acknowledged.

Rapid Military Progress Makes Daily More Urgent the Need for

Post-War Textile Research

By DOUGLAS G. WOOLF

Post-war has been a term which most of us have used to designate some time in the future. It still is in the future, but the time-lag is shortening. Military events on all fronts have been developing so fast that "post-war" in the European theater might be on us sooner than we have had a right to expect, heretofore.

But irrespective of the actual length of time involved, the situation is fluid enough to force upon us the immediate consideration of the many pressing problems which all branches of our national life, and the textile industry specifically, will have to face. To the solution of each of these problems, research is the key.

It is first advisable to define here what we mean by the term "post-war." We are referring not to the immediate period following the war, which might be called the transition period, but to the years which will follow. Let's call it "the next generation" in textiles. Certainly, during "the next generation," the effects of World War II will be paramount just as those of World War I were during the 20 years from 1919 to 1939, to be interrupted not until the start of the defense program and the coming of another war.

Difficult as will be the problems of the transition period itself—involving reconversion, disposal of surplus property, etc., they will be merely temporary phases. In fact, the main importance of that period will be that it will provide the time when a good deal of the long-range post-war direction will be initiated—or ignored.

Research Routes to Follow

That post-war direction should follow several routes. First, there is the perfection of the technical developments which were in the making in the immediate pre-war period, those which have come out of military research, and those which have recently been started in the laboratory for post-war utilization. The important consideration here is that this should be thought of primarily as a public-interest phase of the textile problem. It is through the commercial application of these technical developments that the textile industry can compete for a larger and larger percentage of the consumer dollar. We have to tempt consumers by offering them goods of unprecedented versatility and performance. Technically this is possible. The job is to make it commercially feasible.

That job starts in the cooperative research laboratories but then extends down to the laboratory and product-development department of every individual plant.

Tied closely into this technological problem, as indicated previously in

these columns, is the economic problem. Here again the basic approach must be through cooperative research, with a follow-through on the part of individual companies.

Entwined with both the technological and economic phases are such problems as financing, distribution, etc. None of these can be considered in an air-tight compartment. The question of the utilization of funds for modernization, for example, depends first upon a complete engineering survey—which in turn will draw much of its strength from over-all technical research. The question of whether to integrate vertically—to use another example—depends on such factors as the type of product made, possibility of changes in equipment and personnel, etc., etc.

This looks like—and is—a long job. There is no quick, easy road to research results. Research dollars have been referred to as patient dollars. If they are not that, they are wasted. So it is not at all too soon now to begin to think about the time when there will be an impulse to drop research. Whether it be due to the lack of interest which often comes in cycles, or to depression with its resulting tendency towards retrenchment, is of little importance. One of the tragedies of the private textile depression which preceded the national depression after the last war, was that instead of forcing the industry to invest in the only one sure form of investment at such a time, research, it led to the drying up of what little research there was. For years there was a gap in textile research. The industry has at last started to close that gap. Any attempt to re-open it either now or in the broad post-war period would be suicidal. The history of the last quarter-century in textiles provides a dramatic case study of that fact.

Plastics from Silicon

Based on a framework of silicon and oxygen, the new silicone resins of the Dow-Corning Corporation may be only the first of a large family of organo-silicon compounds of industrial importance. The silicones are resistant to high temperature, possess excellent electrical insulating characteristics, and are remarkably inert chemically. An important use is for impregnation of the fabric insulation on the windings of electric motors. With the silicone resins the motor can safely be operated at higher temperatures and a smaller motor can be operated. The resin is now relatively expensive, but improvements in processing may bring large economies and widen the fields of application.

ABSTRACTS

Members of Textile Research Institute, Inc., desiring complete copies of articles abstracted may obtain photostat copies at cost by addressing the Institute's office, 10 East 40 St., New York 16, N. Y. The price of a photostat negative is seldom more than 30 cents per page of original text.

Translations of articles appearing in foreign language publications and abstracted in TEXTILE RESEARCH, *will be furnished at cost when the original publication is obtainable.*

A list of periodicals abstracted in TEXTILE RESEARCH *and the abbreviations used appeared on page 32 of the January, 1944 issue of* TEXTILE RESEARCH.

ANALYSIS: TESTING: LABORATORY METHODS

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Fluorescence Analysis

Ultraviolet lamps for fluorescence analysis in the textile and related industries. J. A. Radley. *J. Soc. Dyers and Colourists* **60**, 114–19 (May, 1944).

"Fluorescence analysis" has become a valuable auxiliary method of analysis in the textile industry. For this purpose discharge lamps are used almost to the exclusion of other sources of ultraviolet radiation. Spectral radiation from a discharge tube emits a series of sharply defined spectral lines in contrast to the radiation from the carbon arc, the filament lamp, or the sun, which is known as temperature radiation and is continuous. The discharge tube emits energy chiefly in the visible ultraviolet region whereas temperature radiation sources give out much in the infra-red. The theoretical principles underlying the operation of discharge lamps are discussed. It is pointed out for example that when an electron in an "excited" atom returns to its normal orbit re-emitting absorbed energy as radiation, the amount of energy thus given up is related to the wavelength of the radiation emitted; the intensity of any spectral line is a measure of the number of atoms which return by the path responsible for the emission of that particular line; the path taken and hence the spectral line produced is governed by gas pressure, current density and other factors. The various forms in which discharge lamps are commercially available are described and their characteristics noted.

Viscosity of Cellulose

The viscosity of cellulose solutions: methods of experimental determination. Anon. *Silk J. Rayon World* **20**, 28–30 (May, 1944).

The viscometers in general use are based on either Stokes' law or Poiseuille's law. Among those described here are the Stokes, Cochius, Engler, Coulomb, and Wolff instruments. They are criticized as to their disadvantages for use as control instruments in viscose or acetate rayon production. It is stated that a more recently developed viscometer, that of A. Kampf, is far better suited for the purpose. This instrument makes use of a rotating body immersed in the liquid to be measured. The body is rotated by means of a fall weight, the time of fall through a specified distance being measured. Precautions are taken to minimize friction. A photograph of the instrument is given, but unfortunately, it was overexposed and little detail can be made out.

Evaluating the Opacifying Properties of Pigments

New procedure for evaluating the opacifying properties of pigments. Alan P. Adrian. *Paper Trade J.* **119**, 35–41 (Oct. 1944).

A method has been developed for evaluating the opacifying power of a pigment independent of a fiber medium. It is called a film method to distinguish it from the handsheet method. The new method has been demonstrated to give reproducible results as regards specific scattering coefficient and specific adsorption coefficient. The method has been found suitable for

measuring the influence of the compacting of pigment particles, particle size, and admixture with other materials on the light scattering properties of pigment films (these data are not presented in the present publication).

Fiber Identification

Chemical testing methods for fiber identification. Christopher S. Jones. *Textile Age* **8**, 96–9 (Sept. 1944).

The application of staining tests for rapid identification of fibers in mixtures is discussed. Staining shorts are shown which list the shades on different fibers resulting from the application of (1) Neocarmine, developed by A. Gruba & Co.; and (2) the "*Shirlastains*" produced by Imperial Chemical Industries, Ltd., of Great Britain.

Wool Damage

Measurement of damage in wool materials. II. A new test for estimating small amounts of mechanical damage in wool materials. Whewell and Woods. *J. Soc. Dyers and Colourists* **60**, 148–51 (June, 1944).

Previously suggested tests for detecting damage to wool fiber fail to reveal small changes in fiber condition. Such changes may be important because the fibers are then more susceptible to further and serious loss. A test has been devised which utilizes the difference in extent of chlorination of wool caused by difference in degree of fiber damage, followed by subsequent staining with Methylene Blue. The test consists of extracting the wool, immersing in NaOCl solution containing 0.12% Cl and having a pH of 10, for 15 min. at 20 C. It is then washed according to specified procedure, treated with Methylene Blue solution for 5 min., rewashed and dried. From 100 to 200 fibers are examined under the microscope and classified according to the extent of staining into four classes. The test is reasonably reproducible and highly sensitive; for example, the slight effect produced mechanically by gentle hand scouring may clearly be shown.

Wool Fineness

Measurement of wool fineness. Wollner, Tanner and Spiegel. *Am. Dyestuff Reptr.* **33**, 307–8, 321–2 (July 17, 1944).

Two distinct improvements in the standard method of determination of grade of wool are proposed. In customary procedure, as width measurements are made on projected enlarged images of single fibers refocussing is necessary after each of the 100 to 200 or more measurements required. By cutting the fibers into short lengths (about 75 microns) slides may be prepared in which as many as 1600 fibers are grouped in one plane thus eliminating all need for refocussing. A new measuring device is described which is superior both in speed and precision to the wedge ruler commonly used. It consists essentially of a calibrated spiral of Archimedes on a transparent rotary circular plate mounted on a baseboard. The instrument is used by simply rotating the disc until the superimposed fiber image is fitted exactly between a line on the baseboard and the intersection of a normal to this line with the curve of the spiral, when the width may be read directly.

Vegetable Matter in Wool

The determination of vegetable matter content of wool. H. Wollner, L. Tanner and I. Michelson. *Am. Dyestuff Reptr.* **33**, 375–8 (Aug. 28, 1944).

Existing methods for determination of vegetable matter in scoured wool are lacking in accuracy and/or speed. An improved method of analysis has been developed utilizing the difference in optical properties between wool fiber and entangled impurities. The index of refraction of wool (1.555) may be duplicated by a suitable mixture of liquids such as monochloronaphthalene and a petroleum distillate; in such a medium wool becomes transparent, but the impurities having different indices of refraction and colors will be visible and may be quantitatively estimated by comparison with photographic standards prepared on transparent plates. Equipment is set up so that a series of plates may be superimposed until a satisfactory duplicate of the test sample is

built up. From the total impurity weight as represented by the sum of the plates the percent vegetable matter may be calculated. Six of the common types of vegetable matter found in wool are described.

CHEMICAL AND PHYSICAL RESEARCH

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Chlorine Dioxide Manufacture

A new dry process for making chlorine dioxide. E. R. Woodward, G. A. Petroe, and G. P. Vincent. *Chem. Industries* **55**, 58–61 (July, 1944), (Through *Bull. Inst. Paper Chem.* **15**, 4–5 (Sept. 1944)).

Chlorine dioxide has not enjoyed the industrial recognition it deserves on the basis of its merits as an oxidizing and bleaching agent, the principal reason being that it is chemically unstable and must be generated at the point of use. The new dry chlorite process overcomes many of these limitations. The generator used consists of two vertical steel towers, 4 in. in diameter and 3½ ft. high, lined with stoneware or glass and filled almost to the top with flaked commercial sodium chlorite. Chlorine and a large excess of air are fed to the bottom of the first tower, and the chlorine dioxide formed is carried through by the air current into a mixed gas manifold. The operation takes place at room temperature. When the chlorite in the first tower is exhausted, the flow is reversed, the first tower being disconnected, recharged and introduced as the second tower, without interruption to continuous gas generation. Illustrations, diagrams, and a flowsheet are included.

Alkali Solubility of Cellulose

Alkali solubility and degree of polymerization of cellulose. Arnold Marschall. *Zellwolle u. Kunstseide* **1**, 117–22 (Sept./Oct. 1943). [In German] (Through *Bull. Inst. Paper Chem.* **15**, 27–8 (Sept. 1944)).

Rayon pulp of 88% alpha-cellulose content was subjected to the following treatments: (1) oxidation with sodium dichromate solution (2% in dilute sulfuric acid); (2) oxidation with aqueous hydrogen peroxide solution (1% at 100° C); (3) hydrolysis with sulfuric acid in glacial acetic acid (sulfuric acid concentration 2%); (4) hydrolysis with hydrochloric acid (0.1 N at 40° C); (5) aging of alkali cellulose (steeping in 18% sodium hydroxide solution at 18° C; disintegration and aging at 20° C). The polyhomologous series of cellulose preparations thus obtained were tested for solubility in 10% aqueous sodium hydroxide solution and the results plotted against the degrees of polymerization (D.P.) for each series of the treatments. In all cases, the alkali solubility (I) increased with decreasing D.P., however, to a greater extent by oxidation than by hydrolysis, with the exception of the aging of alkali cellulose, which produced only a slight increase in I despite considerable decrease in D.P. Additional data on I and D.P. were obtained from polyhomologous series of cellulose preparations regenerated by saponification of homogeneous and fibrous cellulose acetates, as well as of films and precipitates from solutions of fibrous cellulose triacetates. The I of the cellulose preparations which had been regenerated from the homogeneous cellulose acetates was found to have increased to a much greater extent (with decreasing D.P.) when they were used in moist instead of in dried form. The data on the other series show the pronounced influence of the physical form. Thus, at the same D.P. (400), cellulose regenerated from a triacetate solution by precipitation and subsequent saponification had a I of 58% and by saponification of the films, 18% whereas the fibrous regenerate had 35%. The test results carried out on the same cellulose preparation vary to a certain extent from determination to determination, and this situation (which is not improved by adding to the sodium hydroxide solution noncellulose carbohydrates, as hemicellulose from the press lye, or glucose) calls for a considerable number of individual tests and use of the average value. The determination of the solubility in caustic soda solutions of increasing concentration (from 1 to 10%) of staple fiber spun from the same pulp but under varying conditions showed a distinct solubility-D.P. relationship only when

the sodium hydroxide concentration was from 9 to 10%. At the same D.P., the I varied with the spinning conditions. Whether the I was dissolved in pure sodium hydroxide solution or in the press lye (containing hemicellulose) had only little influence upon the I of the staple fiber. Likewise, the differences caused by drying or one-hour extraction with hot water at 100° C were small. Finally, the I-D.P. relationship was shown by staple fibers prepared from alkali celluloses in which the cellulose had been degraded to a D.P. of 196 and further to 110 and spun from viscoses of 9, 11, and 13% cellulose concentrations. The materials from the 9% viscose showed the highest and those from the 13% viscose the lowest I. The I of these materials was found to run parallel with their ability to swell in water, the 9% viscose producing a swelling value of 74%, the 11% viscose of 71%, and the 13% viscose of 65–66%, whereas the normal swelling value of yarn (spun from an 8% viscose) was about 90%. It is noteworthy that, in contrast to I, swelling in water was found to decrease with decreasing D.P.

Diazotype Process

The basis and practice of the diazotype process. D. J. Brown. *J. Soc. Dyers and Colourists* **60**, 186–7 (July, 1944).

In the diazotype process a positive print is produced by the formation of an azo dye by the coupling of an alkaline phenol with the undecomposed portions of the diazo compound with which the paper is coated; the undecomposed portion corresponds to the opaque portion of the tracing under which the diazotype paper is exposed. The basic chemistry of the process is discussed, and conclusions drawn from research in which some 50 diazotized derivatives of aniline were investigated are summarized. Variations in past and present day practice of the diazotype process are described. Advantages of the diazotype over the blueprint include increased speed, no washing, no shrinkage, positive print and lower cost.

Fabric Properties

Thermal properties of moist fabrics. Charles W. Hock, Arnold W. Sookne, and Milton Harris. *J. Research, Natl. Bur. Standards* **32**, 229–35 (May, 1944); condensed in TEXTILE RESEARCH **14**, 144–49 (May, 1944).

The "chilling effect," or "clamminess," that moist fabrics produce when in contact with the body was evaluated by subjective tests, by measurements of the drop in temperature that ensued when the moist fabrics were placed on an artificial "skin" surface, and by tests with a moisture-sensitive paper designed to measure the extent of contact which the fabrics made with a surface. Using fabrics of various fiber compositions and constructions, a good qualitative reaction was found in these tests. Fabrics which produced considerable chilling in subjective tests were found to make good contact and to cause a substantial drop in skin temperature. Conversely, fabrics which caused little or no clamminess made poor contact and the accompanying drop in temperature was relatively small. The results of these experiments show clearly the progressive improvement of the fabrics with respect to chilling, as their wool content is increased, and also the superiority of certain types of construction that minimize the extent of contact of the fabrics with the skin.

Hemicellulose Determination

Photometric method for determination of hemicellulose. Charles J. Barton and Arthur J. Prutton. *Ind. Eng. Chem. Anal. Ed.* **16**, 429–30 (July, 1944).

A quick photometric method for the determination of organic material from wood pulp dissolved in sodium hydroxide solutions is described. The hemicellulose dissolved from sulfite pulp by stepping in 18% sodium hydroxide is oxidized with a chromic-sulfuric acid mixture containing sufficient sulfuric acid to raise the boiling point to 130 to 140° C where the reaction is essentially complete in one minute. The transmittance of the solution is measured at 600 millicrons with a spectrophotometer or with a red filter in the light beam, if a filter photometer is used. In the red part of the spectrum, the green chromic sulfate has a high absorption and the orange chromic acid has its minimum absorption.

Calibration curves were prepared by determining the hemicellulose content of a number of samples by titration and measuring the transmittance of the solutions at 600 millimicrons. Beer's law holds over a wide range of concentrations, so that only a few determinations are necessary to prepare a calibration curve. A determination can be completed in five minutes.

Properties of Films

Mechanical properties of films from amylose, amylopectin, and whole starch triacetates. Roy L. Whistler and G. E. Hilbert. *Ind. Eng. Chem.* **36**, 796–98 (Sept. 1944).

Amlose and amylopectin triacetates differ greatly in film-forming ability. Amylose triacetate readily forms high-quality films having good tensile strength and pliability; amylopectin triacetate resembles whole starch triacetate in forming only weak, brittle films. Adequate plasticization of the amylose triacetate films can be accomplished by the addition of 10–20% of plasticizer of the types employed with cellulose acetates. In general, the properties of the amylose triacetate films are similar to those of cellulose triacetate films. Because of their high quality and low plasticizer requirements, amylose triacetate films appear well suited to industrial uses.

Resinous Ion Exchange

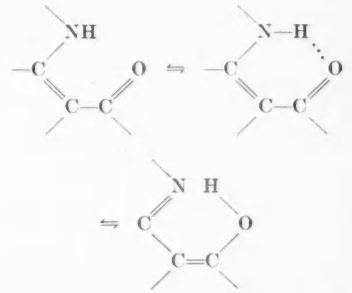
Resinous ion exchange applications. Edward R. Mueller. *Paper Trade J.* **119**, 30–33 (Sept. 1944).

Until the development of satisfactory resinous anion adsorbents the process of deionization, whereby water comparable to U. S. P. single distilled water is obtained, was not commercially feasible. Deionization represents an advanced step in water conditioning over the heretofore restricted applications of siliceous and carbonaceous zeolites. Moreover, the work of Adams and Holmes led to the development of resinous cation exchanges having properties, not exhibited by the zeolites, which insure higher quality treated waters. The use of deionization of water is widespread, due in part to the low cost. Deionization itself is not restricted to water conditioning processes alone, but can be employed in many and varied applications.

Structure of Indigo

The structure of indanthrone, indigo and some of their derivatives. R. Gill and H. Stonehill. *J. Soc. Dyers and Colourists* **60**, 183–6 (July, 1944).

H-bonding, which has been shown to occur in related compounds, is said to occur in the form of a resonance hybrid in indigo and indanthrone as follows:



It is shown that such a structure is in better agreement with theory and experimental facts than the previously advanced polar concept; it is used to explain certain anomalies hitherto not satisfactorily dealt with; among these are (1) the different colors exhibited by indigo in different solvents, (2) the absence in indanthrone of a pronounced color change from leuco to oxidized state, (3) the reduction in the case of indanthrone of only half the total number of quinonoid oxygen atoms to form the normal vat, and others. In the case of item (3) for example, the difference between indanthrone and other vat dyes may be readily explained on the basis that the inner carbonyl groups are not really quinonoid in character, but are modified by H-bonding. The participation of H-bonded structures in dye molecules is probably much greater than previously realized and has very significant applications in color chemistry.

Structure of Staple Fibers

A study of the structure of viscose staple fibers. K. Lauer and W. Mansch.

Zellwolle u. Kunstseide **1**, 39–43 (May/June, 1943). [In German] (Through *Bull. Inst. Paper Chem.* **15**, 32 (Sept. 1944)).

Various types of viscose fibers were first converted into a highly swollen state by treating them with 18% caustic soda solution and subsequently with carbon disulfide in liquid and vapor form. The resulting rexanthated fibers were then placed upon a glass slide and a drop of 18% caustic soda solution was added. The changes in structure were observed and microphotographs taken of the characteristic stages. Depending upon their original type, the rexanthated fibers dissolved more or less slowly in the caustic soda solution. The following kinds were investigated: (1) stretched and non-stretched isotropic fibers which had been spun from an ammonium sulfate bath according to Hermans, from a standard Müller bath, and from a strong-acid bath according to Lilienfeld; (2) staple fibers and for comparison the casein fiber "Lanusa" and the cuprammonium fiber "Cuprama"; (3) staple fibers which had been subjected to formaldehyde in the presence of various catalysts, either immediately after manufacture (moist) or in the dry state. The observations are presented in 22 microphotographs.

Crystallization of Soap Systems

Crystallization of binary and commercial soap systems. R. H. Ferguson and H. Nordsieck. *Ind. Eng. Chem.* **36**, 748–52 (Aug. 1944).

Although the short spacings of x-ray diffraction patterns have proved most suitable for identification of at least four crystalline modifications of sodium soap, it is necessary to turn to the long spacings in order to ascertain the crystallization behavior of the individual fatty constituents of mixed and commercial soaps. The present study, based on long-spacing data, indicates that fractionation into the constituent single soaps is completely absent when anhydrous binary systems crystallize from isotropic melt. Fractional crystallization may occur when there is a sufficient difference in chain length between the two components, but even here the fractions are solid solution phases and not pure components. It appears to be the general rule that commercial soap crystallizes as a solid solution. No evidence of fractional crystallization has been observed in commercial soap.

Solutions of Viscose

The state of solution in viscose. J. J. Stockly. *Kolloid-Z.* **105**, 190–9 (Dec. 1943). (In German) (through *Bull. Inst. Paper Chem.* **14**, 328–9, June, 1944).

A hypothesis is suggested to eliminate the controversy of freely moving macro-molecules versul micelles in commercial viscose (cellulose xanthate solution). This hypothesis is based upon the assumption that cellulose xanthate is present in solution in the form of mixed bodies composed of xanthated and solvated chain molecules and that these mixed bodies retain the original parallel orientation of the cellulose chain molecules.

The state of solution of high polymers. III. Viscosity measurements on viscose. M. Takei. *Kolloid-Z.* **106**, 30–5 (Jan. 1944). (In German) (through *Bull. Inst. Paper Chem.* **14**, 329, June, 1944).

True solvation of the cellulose xanthate particles increases and the particle size decreases with increasing time of aging of the alkali cellulose. The essential phenomenon during the aging of alkali cellulose consists of partial disorientation of the crystalline regions. Whereas viscose from unaged alkali cellulose possesses a primary structure, viscose from an aged solution develops a secondary structure. True solvation decreases with increasing ripening degree of the viscose, and the rate of decreased solvation is more rapid, the longer the alkali cellulose has been aged. On the other hand, the particle size shows no, or only little, change. Both solvation and micelle size change less during ripening, the more carbon disulfide is used in the preparation of the viscose. The state of solution is not changed by adding varying amounts of carbon disulfide, provided a certain quantity of it has been taken up previously by the alkali cellulose. The solvation of the xanthate in 4 and 7% sodium hydroxide solutions shows no essential difference, al-

though the particle size is influenced to a certain extent by the caustic soda concentration. On the other hand, the xanthate undergoes considerable hydration if it is dissolved in water, and in this solution, the micelle particles possess the largest size. It is suggested that the viscose particles in commercial viscose are arranged in a lattice of fringed micelles.

Demineralization of Water

The demineralization of water by ion exchange. William E. Manring. *Paper Trade J.* **119**, 33–36 (Sept. 1944).

Two newly developed synthetic ion-exchange resins, Ionac C-284 and Ionac A-293, cation and anion active resins respectively, are described. Particular attention is directed to their performance in a four-bed system, comprised of alternate beds of the cation and anion resins, as applied to the demineralization of water. Applications of the four-bed system in (1) the treatment of brackish water, (2) a portable disposable cartridge unit, and (3) a self-contained laboratory unit of 30 gallon per hour capacity, are described in detail.

Scale Cells of Wool

Electron microscope pictures of isolated scale cells of sheep wool. H. Zahn. *Melliand Textilber.* **24**, 157–60 (Apr. 1943). (In German) cf. *B.I.P.C.* **14**, 36 (through *Bull. Inst. Paper Chem.* **14**, 342, June, 1944).

Further electron microscope pictures are presented of wool cells and fragments isolated by degradation with the enzyme pancreatin. The fibrils isolated from the spindle cells show the identical structure as that determined within the cell unit; they are very long, about 100–500 wide, and arranged in parallel. Degraded scale cells and fragments are sufficiently thin to be readily penetrated by the electron beam; they show elongated structures, pores, and longitudinal fissures of 10 to 100 width. The following structures have so far been identified in sheep wool: (1) fibrous building units (spindle cells, fibrils, and microfibrils); (2) flat structures (sharply defined scale cells of elongated structure, traversed with fine pores and fissures); and (3) the porous subcuticle of netlike structure. 10 illustrations and 12 references.

BLEACHING: DYEING: FINISHING

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Peroxide Bleaching

Continuous peroxide bleaching. The technical staff of the Buffalo Electrochemical Co., Inc. **I. Its development.** *Am. Dyestuff Reptr.* **33**, 345–6 (Aug. 14, 1944). **II. Operation.** *Ibid.* 365–8, 380 (Aug. 28, 1944).

The peroxide bleach is extremely flexible enabling use of any desired temperature and permitting numerous modifications; the end product for example may be fully absorbent white goods or bleached nonabsorbent yet mote-free goods. This flexibility makes it eminently suitable for continuous bleaching. Important steps in the development of present continuous methods were first the discovery that goods saturated with fairly concentrated peroxide could be bleached in the cold, and second that the bleaching time of goods so saturated could be greatly reduced by treatment with steam. Development of this method has effected such production increases and so reduced chemical costs that peroxide bleaching costs are now in line with the cost of chlorine bleaching. Goods may be processed in open width or rope form. The choice of many possible ways to route goods through continuous peroxide bleaching depends upon such factors as the character of the goods, the degree of bleaching required and the cost of processing. Whatever pretreatments are required (e.g., water washing, acid treatment, caustic steam or combination of these) as well as the bleaching proper, may be carried out in the same type of apparatus, a basic unit of which consists of a saurator, a J-box, and a washer. Saturation of incoming wet cloth is accomplished by giving an initial heavy squeeze, passage through a box of treating solution kept at constant level, and a final squeeze. Heat treatment is carried out in a J-box which is designed to bring the goods to the desired temperature by steam application

counter-current to the cloth flow, and hold them at that temperature for the desired time. Final equipment in the unit is a washer, which may be tight strand or slack; the limiting speed of the whole process is set by the washers. Generally two basic units are employed, one for the caustic prepare and one for the actual bleaching. The line is obviously long and DC motors are best suited to the synchronized operation of the many parts; electron tubes may be utilized to furnish DC power direct from AC lines. The ultimate objective is one man operation of the whole bleaching range and this will doubtless involve a central control station employing such devices as electronic cloth level indicators, and conductivity meters to show chemical concentrations.

Sizing Acetate Rayon

The sizing of acetate rayon with linseed oil emulsions. E. Sauer and G. Geldmacher. *Kolloid-Z.* **100**, 425–35 (1942); *Chem. Zentr.* 1943, II, **91** (through *Chem. Abstr.*, 1944, **38**, 4451[6]).

Data on sizing and possibilities of fiber damages caused by sizes are presented. Aqueous linseed oil emulsions with and without driers and softening agents were applied to lustrous and to delustered acetate rayon. As softening agents were used glues, oils, waxes, soap, Turkey-red oil, stearic acid, paraffin oil and sodium caseinate; as drier, Pb-Co-Soligen (I. G. Farben-industrie). Viscosity and pH had no effect on the results. The addition of drier gives a coarser dispersion. The degree of the dispersion and softening agents had no effect on the stability of the emulsions. The softening agents act as protective colloids. Delustered rayon absorbs more size than does lustrous rayon, increases more in strength and loses less strength in storage. Sized acetate rayon showed only slight fiber damages after seven months; the damages are greater with desized yarns. Softening agents, particularly gelatin and Marseilles soap, delay the fiber damage in acetate rayon.

Wool Dyeing

The theory and practice of wool dyeing. Levelling and stripping of dyed material. C. L. Bird. *Am. Dyestuff Reptr.* **33**, 346–8 (Aug. 14, 1944). (Reprinted from the *Textile Recorder*, May, 1944.)

Stripping or partially stripping the color from dyed wool is necessary for the purpose of remedying faulty dyeings, for treatment of rags in the manufacture of shoddy, and in the garment dyeing trade. The process inevitably damages wool to a certain degree, depending on the severity of the method employed. Six important methods of levelling and stripping are described and their effects discussed. The agents used are, roughly in order of stripping effectiveness, (1) Glauber's salt, (2) ammonia, (3) soda ash, (4) sulfuric acid, (5) bichrome and sulfuric, and (6) sulfoxylate formaldehyde and sodium hydrosulfite. The chemical action involved in these treatments is briefly shown. Choice of method is governed by the nature of the material, the dyes present, the existing shade and the desired shade.

FIBERS: YARNS: FABRICS: MECHANICAL PROCESSES

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Creasing

Cause and prevention of creasing of artificial cellulose fibers. Hans Joachim Henk. *Jentgen's Kunstseide u. Zellwolle* **25**, 144–5 (1943); *Chem. Zentr.* 1943, II, **284** (through *Chem. Abstr.*, 1944, **38**, 4451[5]).

The lack of elasticity is explained through the structure of cellulose and by a comparison of cellulose with elastic fibers. This can be improved only to a slight degree. On the other hand, the hydrophilic properties of artificial fibers can be eliminated by formylation, acetylation, the use of certain cellulose thiorethanes, and urea- or phenolformaldehyde condensation products. The distribution of the resin in the fiber is very important. An ideal solution of the problem has not been proposed.

Flax and Hemp Fibers

Determination and uses of flax and hemp fibers. A. C. Whitford. *Textile Age* **7**, Nos. 3–12 (Mar.–Dec. 1943); *Ibid.* **8**, Nos. 1–5 (Jan.–May, 1944).

In a series of 15 articles the author discusses the various bast fibers, methods of identification and chief uses. Photomicrographs of cross sections of the various fibers are included.

Natural and Synthetic Fibers

The molecular structure of natural and synthetic fibers. Charles S. Venable. TEXTILE RESEARCH **14**, 179–82 (June, 1944).

The author explains the principal concepts held in regard to the structure of textile fibers. The molecular structure together with an appraisal of their properties is given for the following: silk, wool, nylon, vinyon, cellulose, and cellulose derivatives.

Properties of Nylon Yarns

Physical-chemical properties of textile nylon yarns. Staff Nylon Division, E. I. du Pont de Nemours & Co. *Rayon Textile Mo.* **25**, 53–5 (May, 1944).

Nylon is subject to damage by some insects, e.g., moths, black carpet beetle, firebrats and certain varieties of ants. Moths do not appear to use nylon as food as in the case of wool. Nylon is unusually resistant to molds and bacteria although some finishes permit mold growth, but with little damage to the nylon ensuing. When exposed to fresh and salt water intermittently for 6 months, nylon lost about 20% of its tensile strength. Nylon is quite vulnerable to sunlight, although not so much so as silk. Data are given for exposure tests at Wilmington comparing nylon with other fibers. While bright nylon compares favorably with cotton, rayon and linen, semi-dull nylon lost about 50% of its tenacity upon exposure for 16 weeks. The moisture regain of nylon is less than that of the usual textile fibers, ranging from 1.1% to 10% R.H. and 75° F. to 6.2% at 97% R.H. The regain over this range of humidities is tabulated for the 75° F isotherm. Water, 10% NaOH, and glycerine cause no lateral swelling of nylon at room temperature while boiling 10% Glauber's salt causes about 3% swelling. Shrinkage data under a variety of conditions are given for sized, oiled and twist set nylon yarns. Nylon yarns immersed in 5% cresylic acid at 50° C for 5–10 minutes shrank to almost 50% of their original lengths. In addition to size and oil, nylon contains about 1% extractable material, the exact amount depending on the severity of the scouring conditions. The measurement of the shrinkage of nylon is discussed in great detail. Repeated tests indicated that nylon possesses no toxicological properties and is incapable of causing dermatitis. Reported cases are said to be traceable to the finishing material used.

Rayon

Fibers of high strength and their applicability. A. Zart. *Die Chemie* **55**, 11–13 (Jan. 3, 1942) (through *Bull. Inst. Paper Chem.* **14**, 420, Aug. 1944).

Reference is made to the improved strength properties, particularly the wet strength, of the staple fibers Flox, Phrix, Vistra, and Duraflox which are all prepared by the viscose process, and subjected to a stretching procedure at the moment of the transition from the liquid to the solid state. However, when compared with native cotton, the staple fibers are still inferior with regard to wet strength, twisting strength, bending endurance, and swelling ability. For wearing apparel, the handle of the material does not remain after washing as in cotton. Subsequent treatment with formaldehyde or impregnation with urea or formaldehyde does not give permanent improvement. In spite of the advances made, further developments are essential.

Carbonization of Fabrics

The carbonization of wool and of mixed fabrics of wool and acetate spun rayon. Gerd Nitschke. *Melliand Textilber* **23**, 548–51 (1942); *Chem. Zentr.* 1943, **I**, 2463–4 (through *Chem. Abstr.*, 1944, **38**, 4451[3]).

A discussion, based on previous experimental work, of the conditions and the course of carbonization, particularly of mixed wool and acetate spun rayon piece goods.

Raw Materials for Rayon

Raw materials in rayon production. A. G. Arend. *Silk J. Rayon World* **20**, 24, 26, 34 (May, 1944).

The principal raw materials used in viscose manufacture are cellulose, sodium hydroxide and carbon disulfide. To insure a standard quality product, the purity of these must be carefully controlled. Commercial methods of obtaining these materials with a high degree of purity are described. Criteria of purity are also given.

Soybean Fiber

The soybean fiber as seen by a wool man. Werner Von Bergen. *Rayon Text Mo.* **25**, 57–8 (May, 1944).

The process of manufacture of soybean fiber is given as described by Boyer, Director of Research for the Drackett Co., manufacturers of soybean fiber. The author describes his examination of soybean fiber as follows: in luster, touch and crimp, it very closely resembles staple rayon, but it has a poor light tan color. Under the microscope the fibers are seen to be nearly circular and highly uniform. Fineness measurements are tabulated comparing the Drackett product with the fiber as produced in 1939 by Ford. The data show the present product to be superior in fineness to the 1939 product. The dry tensile given is 11450 p.s.i., as compared with 21000 p.s.i. for 62's wool top. The corresponding wet tensiles are 4240 and 17700 respectively. The moisture content at 65% R.H. and 70° F was 16.1% on the wet side and 12.9% on the dry side, thus exhibiting a similar hysteresis to that of wool. The fiber is strongly acid as indicated by the p.H. of 2.7. The solubility and swelling data show that the fiber has been much improved over the 1939 product. The fiber resists carbonizing with 4% sulfuric but turns yellow. Some harshness and brittleness is observed when the fibers are treated with acid, the original softness being partially restored when the acid is neutralized. The fiber exhibits a high affinity for acid and chrome dyes.

Properties of Blankets

A study of the properties of household blankets. Herbert F. Schiefer, Hazel Tharp Stevens, Pauline Berry Mack, and Paul M. Boyland. *J. Research Natl. Bur. Standards* **32**, 261–84 (June, 1944).

The fiber composition, weight, thickness, compressibility, compressional resilience, thermal transmission, air permeability, breaking strength, and shrinkage of 156 different blankets are recorded. The effects of laundering; of laundering and renapping; of laundering, renapping, and abrasion; of dry cleaning and renapping; and of dry cleaning, renapping, and abrasion on these properties of a large number of blankets are shown. A linear relationship was found between the compressional resilience and the wool content of cotton-wool blankets. The thermal transmission of the blankets was found to be independent of the kind of fiber. The reciprocal of thermal transmission was found to be related linearly to the thickness. The thermal transmission computed by means of the equation $1/T = 3.0t_{0.1} + 0.63$, where T is the thermal transmission in Btu/(°F hr ft^2), and $t_{0.1}$ is the thickness in inches at a pressure of 0.10 lb/in.^{2}, was found to agree with the measured values within ± 10 percent, 95 times out of 100. Empirical relationships were also found among thermal transmission, thickness at 1.0 lb/in.^{2}, and compressibility; and among thickness at 0.10 lb/in^2, compressibility and weight. The relation between breaking strength and weight, and that between breaking strength and compressibility, are discussed. Minimum requirements are suggested for the properties of blankets for use in a performance specification.

Serviceability of Table Napkins

Serviceability of linen, cotton with a permanent finish, and rayon and cotton table napkins. Lottie E. Sumner and Elizabeth D. Roseberry. *Rayon Text. Mo.* **25**, 53–6 (Aug. 1944).

Linen, cotton with a permanent finish, and rayon and cotton table napkins, at different price levels were put into service in a college dining hall where they were used over a period of 32 weeks, during which time each napkin was used by one person for 3 days of each week and then laundered in the school laundry. The deterioration was greatest in the linen napkins, as is indicated by both loss in breaking strength and weight per square yard. In general, this deterioration was less in the cotton fabrics

with permanent finish than in the linen fabrics. The finish was still effective in preventing linting and in giving a firm handle to the fabric after 32 launderings. The rayon and cotton napkins gave satisfactory wear. The rayon yarns of all of the rayon and cotton fabrics resisted deterioration more than the cotton and linen yarns used in the fabrics in this study. The shrinkage in laundering of the fabrics under laboratory conditions did not predict the shrinkage under actual laundering conditions. Even though the temperature was higher by 50 degrees in the laboratory laundering, the shrinkage was not as great.

Automatic Weaving

50 years of progress in automatic weaving. C. W. Bendigo. *Textile World* **94**, 77–87 (Aug. 1944).

The more important developments in automatic looms are briefly described. The principal developments in loom motions are traced pictorially commencing with a reproduction of an old wood cut showing the warp let-off motion of one of the earliest Northrop automatic looms (1894).

MISCELLANEOUS

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The Cotton Card

The evening action of the cotton card. R. W. Vose and C. H. Plummer. TEXTILE RESEARCH **14**, 20–4 (Jan. 1944).

An investigation was made by the research division of the Chicopee Mfg. Corp., of the extent to which the conventional cotton card averaged out the irregularities present in the conventional picker lap. An experimental procedure was devised in which identifiable lap irregularities of known amounts were introduced and the resulting irregularity was traced in the card sliver. In this way the irregularities of the card sliver which originated in the lap could be segregated from those which originated in the card. A comparison between the magnitude of the original lap and the corresponding sliver irregularity was then used as an index of the amount of evening which could be expected of the card. The card sliver produced was evaluated by means of the Saco-Lowell S liver Tester. Sample sliver tester charts are shown which indicate the distinctness with which the sinusoidal lap feed is reproduced in the sliver. It will be seen that irregularities of shorter than ½″ wave lengths in the lap are largely absorbed by the card and do not appear in the sliver. Those irregularities of longer than 8″ wave lengths are reproduced essentially completely, without any modifications by the card. In the range between these two lengths the card exerts a partial evening action. While it is beyond the scope of these particular experiments, it may be stated that the shorter wave length irregularities in a lap are likely to be due to poor sheet formation on the screen of a picker or to irregular drive on the screen, while the longer wave length irregularities are traceable to poor evener motion action.

Cotton for Plastic Laminates

Cotton textiles for plastic laminates. Charles K. Everett. Bulletin, The Cotton Textile Institute, Inc. Condensed in TEXTILE RESEARCH **14**, 11–14 (Jan. 1944).

This report, based on the author's personal investigations, is intended to help visualize: (1) how wartime exigencies have affected the demand for plastic laminates, with resultant changes in the character of products and manufacturing operations. (2) What are—from the laminators viewpoint—the deficiencies and shortcomings of cotton textiles in relation to competing materials, and (3) what are some of the outstanding problems presenting themselves for basic and applied research study if cotton textiles are to improve or even hold their present place as the reinforcing elements in plastic laminates.

Cloth Handling

The dynamics of flowing cords. R. W. Vose. TEXTILE RESEARCH **14**, 105–12 (Apr. 1944).

The behavior of fast-running cords is analyzed with particular reference to the behavior of ropes of cloth encountered in a textile finishing plant. Theoretical formulas are deduced whereby the behavior at any point may be calculated, and from them practical deductions are drawn for direct use by the engineer.

Grex Numbering System

The Grex universal numbering system. A. G. Seroggie. TEXTILE RESEARCH **14**, 17–19 (Jan. 1944); *ibid.* 36–39 (Feb. 1944).

A brief outline is given of the new Grex (grams per 10,000 meters) system. Grex is a direct decimalized unit which can be applied to fibers, filaments, slivers, tops, and rovings as well as yarns. The advantages of Grex over other systems in common use are explained.

High Frequency Heating

High frequency heating. R. R. Baker and C. J. Madsen. *Paper Trade J.* **119**, 25–30 (Aug. 24, 1944).

Inductive and dielectric heating are defined and a short discussion of the inductive process is presented. The principles of dielectric heating are discussed and the basic equations for the determination of the varied factors required for a particular application are given. The loss factors and specific heat are listed for a number of materials. The spacing of the electrodes is given consideration. The use of dielectric heating is of particular value in the processing of thick sections but the economic aspects must not be neglected in determining its application. Examples are given which indicate the possibilities and limitations of this type of heating in the paper and paperboard industry.

Synthetic Resin

Duralon from oat hulls. United States Stoneware Co., Akron. *Chem. Eng. News* **22**, 852 (May 25, 1944); *Chem & Met. Eng.* **51**, 149, 151 (May, 1944); *Chem. Industries* **54**, 696–7 (May, 1944) (through *Bull. Inst. Paper Chem.*, 1944, **14**, 377).

Reference is made to a furane derivative developed from agricultural waste products, such as corn cobs and oat hulls. Complete stability of the resin has now been secured; the previous lack of this property made any great use impossible. The material is suggested as a coating, impregnant, adhesive, as a modifying agent in synthetic rubber, etc.

Redwood Bark

Chemical composition of redwood bark. H. F. Lewis, F. E. Brauns, M. A. Buchanan, and Ervin F. Kurth. *Ind. Eng. Chem.* **36**, 759–64 (Aug. 1944).

Redwood bark is separated commercially into two fractions, "bark fiber" and "bark dust." The former is used for insulation and is blended with various fibers for textile and related purposes. Bark fiber is inherently a cellulose fiber. After delignification it swells with cuprammonium solution as does a wood fiber. In its raw state the cellulose appears to be combined with lignin by a linkage which is resistant to splitting by caustic soda or by phenol and acid. Part of the lignin appears to be closely related structurally to sprucewood lignin. One other compound appears to be associated with the fiber in its raw state—a low-methoxyl phenolic acid; a second may be present, which closely resembles lignin but contains a definite percentage of carboxyl groups. The first of these is readily soluble in alkali; the second is somewhat more difficultly soluble. Small amounts of catechol-type tannins and phlobaphenes and a carbohydrate gum are also present in the fiber. Bark dust represents a heterogenous mixture of broken fibers and parenchyma cells, together with a large amount of the low-methoxyl phenolic acid found in the fiber. This substance probably makes up 70–80% of the bark dust. The carbohydrate gum present in the fiber is also present in the dust to the extent of 8–9%. It is soluble in hot water and precipitated with alcohol, and at least half of it is peptic acid. Small amounts of catechol-type tannins and phlobaphenes are likewise present in the dust.

An Unpredictable Year

Research is the only sure prediction for an unpredictable year. Douglas G. Woolf. TEXTILE RESEARCH **14**, 2–7 (Jan. 1944).

In the author's words "this is an attempt to look into the future—into 1944 and beyond—from the standpoint of textile research. Since the trend of every phase of textile activity depends very largely upon research, this is a summary of the textile outlook as a whole."